Chapter 8: Infrastructure

1 Overview and Key Findings

There are basically two kinds of infrastructure in the Delta: the kind that adds to the economic sustainability of the Delta and the kind that is just passing through, often with negative effects. Some idea of the variety and extent of the infrastructure in the Delta is provided by Figure 33.[95]

Three broad categories of infrastructure that serve the Delta economy are reviewed and analyzed within the framework detailed in Chapter Five: (1) Transportation; (2) Energy; and (3) Water Resources and Flood Control.

This chapter focuses on water supply and other infrastructure that directly serves communities within the Legal Delta and the adjacent region but also includes mention of infrastructure that basically serves other regions.

The key findings are:

(1) Transportation and energy are important components of the economy of the Delta region. Maintenance of the levee system in order to protect transportation and energy infrastructure is crucial.

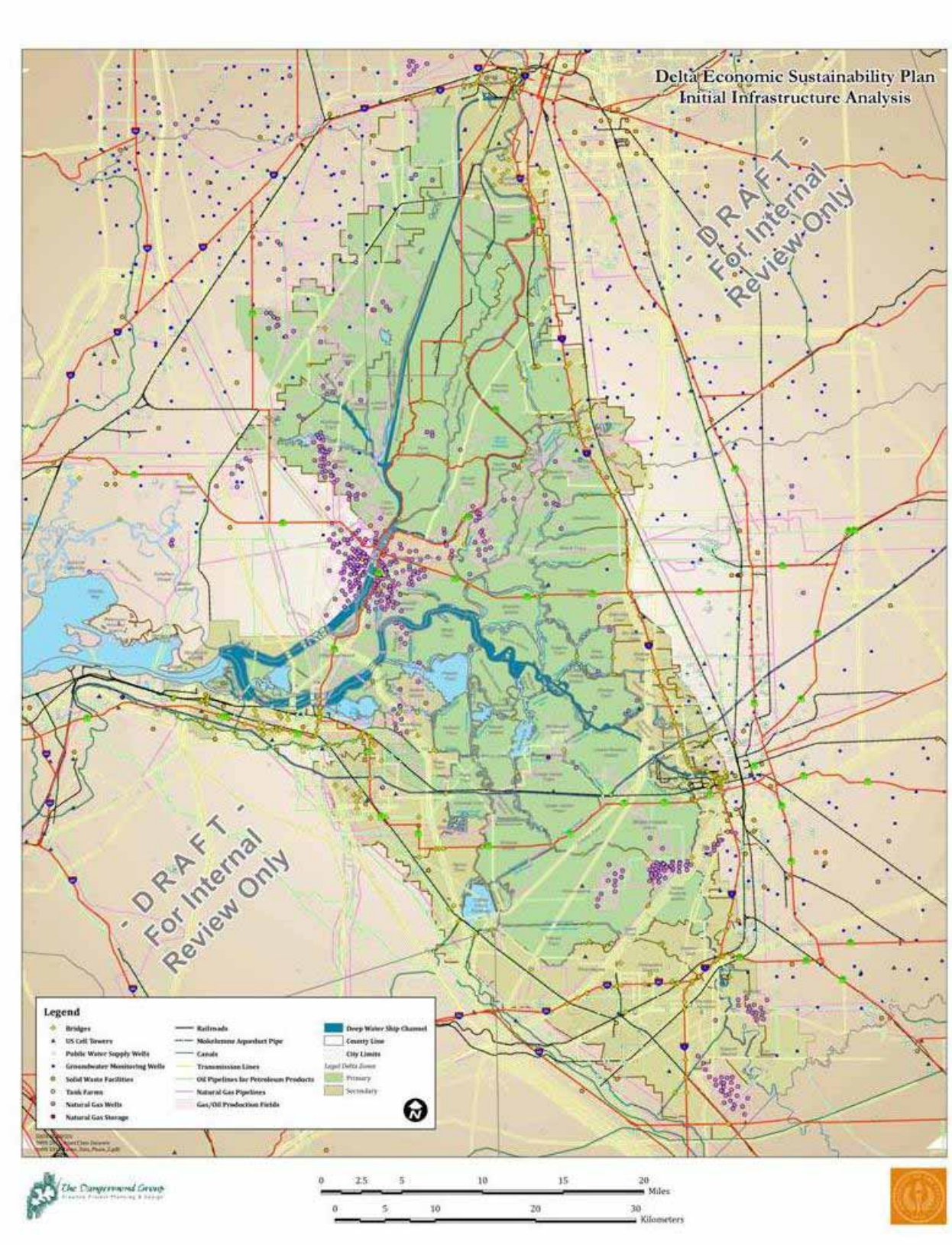
(2) Extraction of water from the Delta is critical to the economy of the Delta region. Any decline in water quality—whether it is an increase in salts or organic carbon—has very negative effects on both agriculture and urban water supplies. Delta water quality is potentially threatened by both the kind of isolated conveyance being studied as part of the BDCP and by some of the conservation measures that are being proposed as part of BDCP. Delta water quality would also be threatened by the six-islands open-water scenario, but it can be protected, even in the face of sea-level rise, by improving Delta levees to a higher standard and restoring or developing tidal marshes in the far western Delta, downstream of Sherman Island and in the Suisun Marsh. A key to not only maintaining the present levels of Delta water quality but improving it, with benefits both for human use and the ecosystem, is cleaning up the San Joaquin River, whether by order of the State Water Resources Control Board or some other means.

(3) An example of a win-win solution is provided by the proposed Lower San Joaquin River Bypass, which, while it would both reduce peak water surface elevations in the San Joaquin River adjacent to Lathrop and Stockton and provide ecosystem benefits by activating floodplains, would only contribute increased organic carbon for a relatively short period of time and at periods of high flows, so that the impacts on water quality would be minimized.

(4) Infrastructure that passes through the Delta should financially contribute to the maintenance and improvement of the levee system on which it relies. This includes but is not limited to through-Delta conveyance of water.

[95] Based on DRMS GIS data set developed by URS Corporation and provided by DWR.

Figure 33 Select Delta Infrastructure



2 Transportation

The Framework study identified the important role that Delta's transportation infrastructure has in linking the large regional population and diverse concentration of agricultural producers, retailers, manufacturers and distributors.[96] All primary modes of transportation are located in the Delta.

2.1.1 Trucking and Automotive Transportation

There are three state highways in the Delta's Primary Zone (SR 4, SR 12, and SR 160). These highways are principal road transit routes through that region. In addition, the Delta's Secondary Zone hosts three Interstate freeways (I-5, I-80, and I-205) and is bordered by two others (I-580 and I-680). The 2007 Delta Vision Status and Trends report identified evidence of Delta traffic growth disproportionate to population growth.[97] That trend continues to be evident in recent years. Table 41 reports an index of daily total vehicle trips (DTVT) on these transportation corridors between 1992 and 2009 as well as actual 2009 DTVTs. Accordingly, excluding some sections of SR 160, traffic volumes on highways and freeways increased between 23 percent and 65 percent during this period. In comparison, population in the five-county region increased by 20 percent, ranging between 12 percent (Solano County) and 26 percent (Yolo County and San Joaquin County) during the same period.[98]

Table 41 Daily Total Vehicle Trips (DTVT) on Key Transportation Routes 1992-2009

Route	Intersection	1992	1995	2000	2005	2006	2007	2008	2009	2009 DTVTs
CA-12	CA-84 (Rio Vista)	100	93	111	147	150	150	134	129	***39,000***
CA-12	I-5 (Lodi)	100	99	97	151	153	153	134	134	***31,000***
CA-160	CA-220 (Walnut Grove)	100	64	73	80	81	81	70	70	***4,700***
CA-160	Wilbur Ave (Antioch)	100	94	113	125	140	136	124	123	***25,000***
CA-160	Isleton Bridge (Isleton)	100	71	73	80	81	81	73	73	***6,150***
CA-4	Byron Highway (Byron)	100	108	125	131	123	125	112	117	***38,600***
CA-4	Roberts Road (Stockton)	100	115	N/A	N/A	165	153	139	135	***19,400***
CA-4	Port Chicago Freeway (Concord)	100	105	140	184	177	179	171	165	***277,000***
I-205	Old Route 50 (Tracy)	100	115	139	169	170	170	180	160	***195,000***
I-5	I Street (Sacramento)	100	116	133	161	166	167	155	159	***364,000***
I-5	CA-12 (Lodi)	100	103	113	166	169	169	156	156	***130,000***
I-5	French Camp Overcross (French Camp)	100	105	108	174	176	176	159	159	***196,000***
I-80	I-5 (Sacramento)	100	82	114	124	127	134	128	126	***231,000***
I-80	CA 113 (Davis)	100	107	123	137	135	130	126	135	***246,000***

Source: Caltrans traffic volume data. Traffic Data Branch. Accessed 2011/6/30: http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm

The decline in vehicle traffic along SR 160 is notable as it has Scenic Roadway designation and as such would seemingly indicate an important driving-for-pleasure resource within the Delta. When examined, the decline in vehicle traffic seems to have occurred primarily between 1992 and 1995, with a fairly sustained period of relatively flat traffic volumes along SR 160 in the northern Delta between 1995 and 2009, and with some growth in the southern portion of the route.[99]

[96] DPC 2010 *Final Draft Delta Protection Commission Economic Sustainability Plan Framework Study Volume II.* Delta Protection Commission. December 6, 2010.
[97] DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft. Department of Water Resources. March 2007.
[98] Population calculations based on U.S. Department of Commerce, Bureau of Economic Analysis data downloaded from the *California Regional Economic Analysis Project on 6/30/2011.*
[99] See Chapter 7 Recreation and Tourism for a discussion of trends in driving for pleasure in the Delta.

The trends in truck traffic are more diverse as indicated in Table 42. Truck traffic has decreased markedly in some areas, such as the 45 percent decline in truck traffic on I-80 near Davis. However, truck traffic has increased in other areas, particularly along the I-5 corridor where traffic increased by 112 percent near Lodi, 66 percent near Sacramento, and 59 percent near French Camp.

Table 42 Daily Total Truck Trips (DTTT) on Key Transportation Routes 1992-2009

Route	Intersection	1992	1995	2000	2005	2006	2007	2008	2009	2009 DTVTs
CA-12	CA-84 (Rio Vista)	100	90	87	136	137	137	120	120	3,871
CA-12	I-5 (Lodi)	100	78	76	90	92	92	83	83	4,519
CA-4	Byron Highway (Byron)	100	80	124	130	123	124	111	116	5,775
CA-4	Roberts Road (Stockton)	100	103	137	76	164	152	138	134	2,471
CA-4	Port Chicago Freeway (Concord)	100	97	109	139	134	135	129	124	14,779
I-205	Old Route 50 (Tracy)	100	114	138	103	104	104	110	94	12,240
I-5	I Street (Sacramento)	100	120	136	166	171	173	162	166	17,856
I-5	CA-12 (Lodi)	100	142	144	231	233	233	212	212	23,459
I-5	French Camp Overcross (French Camp)	100	124	138	151	153	174	159	159	49,480
I-80	I-5 (Sac)	100	111	156	131	134	140	135	132	16,428
I-80	CA 113 (Davis)	100	59	69	55	53	54	52	55	8,107

Source: Caltrans traffic volume data. Traffic Data Branch. Accessed 2011/6/30: http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/index.htm

These highways and freeways are represented in Table C2 in Appendix C. Based on the DRMS database approximately 337 miles of this highway and freeway infrastructure are located within the Delta's 100-year flood plain.[100] In addition to the highways and interstate freeways, the Delta 100-year flood plain alone is estimated to contain 1,456 miles of minor road infrastructure.[101]

Interconnecting this terrestrial transportation infrastructure are 31 bridges in the 100-year flood zone. Many of these bridges need capacity upgrades to meet current capacity standards.[102] There are also five operational ferries in the Delta; two of the five ferries are operated by Caltrans and the other three ferries are privately operated.[103]

2.1.2 Rail Infrastructure

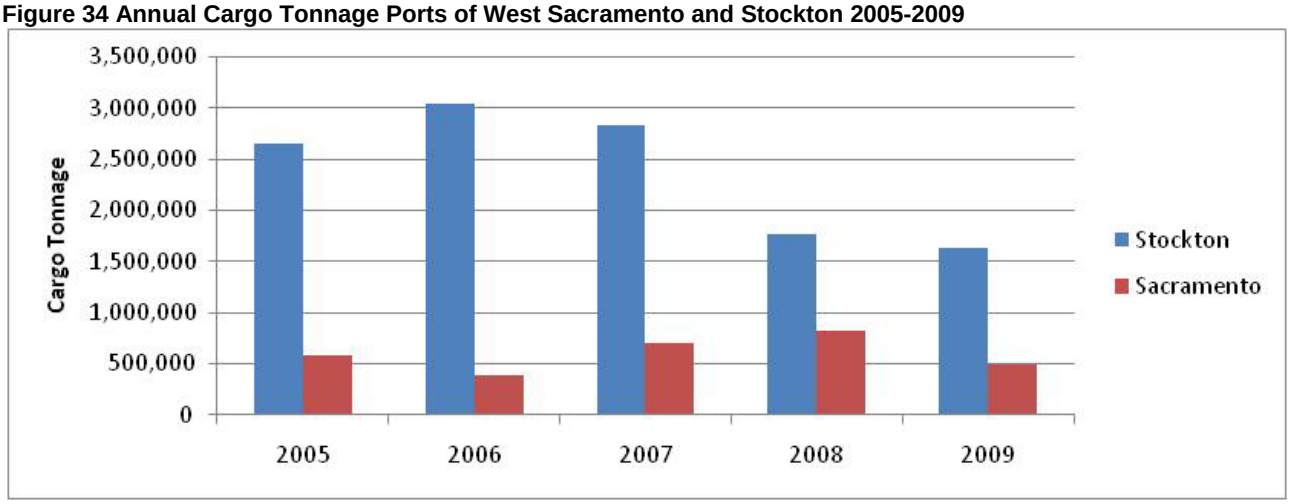
The Delta's short-line railroad was historically an important transportation resource for the region's agricultural industry.[104] Two transcontinental railways pass through the Legal Delta: the Burlington Northern Santa Fe (BNSF) railway and the Union Pacific railroad. These lines primarily carry freight and form a critical component of the regional transport infrastructure with multimodal linkages to the area's trucking and maritime infrastructure. In addition to freight transportation, the Amtrak San Joaquin route from Bakersfield to Sacramento/Oakland is a significant passenger rail line; it passes through the Legal Delta and carried just over 960,000 riders in 2010.[105]

[100] DRMS 1
[101] DRMS 1
[102] NARPRAIL 2011 *Amtrak Fact Sheet: San Joaquin Service*. Status *and Trends of Delta-Suisun Services*. Public Review Draft.
[103] Caltrans 2011 *SR-12 Comprehensive Corridor Evaluation and Corridor Management Plan from SR-29 to I-5.*
[104] DPC 1994 Utilities and Infrastructure. Background Report.
[105] DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft.

2.1.3 Ports and Maritime Infrastructure

The Stockton Deep Water Ship Channel was constructed in 1927 and the Sacramento Deep Water Ship Channel in 1963.[106] The Port of West Sacramento is located 79 nautical miles from the Golden Gate Bridge and consists of 150 acres of operating terminals that currently handle a variety of bulk, break-bulk (general cargo), and project cargos. The Port of Stockton is located 75 nautical miles from the Golden Gate Bridge it operates a diversified transportation center that encompasses 2,000 acres of operating area.[107] These ports are currently developing a marine highway for short sea shipping collaboratively with the Port of Oakland. This marine highway will reduce truck transportation of containers on the San Francisco Bay Area's congested road infrastructure through regularly schedule barge service.[108] When the marine highway is fully operational, these two Delta ports will further deepen the regions' freight transportation infrastructure and significantly deepen multi-modal linkages.

Figure 34 Annual Cargo Tonnage Ports of West Sacramento and Stockton 2005-2009



Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics Center. http://www.ndc.iwr.usace.army.mil//wcsc/webpub09/webpubpart-4.htm Accessed: 2011-06-30.

2.1.4 Air Transportation Infrastructure

There are 11 general aviation airports located within the Legal Delta. Besides these facilities, there are also small landing strips for property owners' use and small agricultural air strips used by commercial crop-dusting services.[109] Sacramento International Airport and Stockton Metropolitan Airport both are located near the Legal Delta.

[106] DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft.
[107] http://www.portofstockton.com/ Accessed/2011-06-30
[108] Port of Stockton 2011 *Marine Highway Project Brochure*. http://www.portofstockton.com/Downloads/SSS%20Brochure.pdf
[109] DPC 1994 *Utilities and Infrastructure*. Background Report.

Table 43 Aviation Facilities in the Legal Delta

Name	County	City	Category
Byron Airport	Contra Costa	Byron	General Aviation
Las Serpientas Airport	Contra Costa	Brentwood	General Aviation
Funny Farm Airport	Contra Costa	Brentwood	General Aviation
Spezia Airport	Sacramento	Isleton	General Aviation
Tracy Municipal Airport	San Joaquin	Tracy	General Aviation
Kingdon Airport	San Joaquin	Lodi	General Aviation
Lost Isle Seaplane Base	San Joaquin	Stockton	General Aviation
New Jerusalem Airport	San Joaquin	Tracy	General Aviation
33 Strip Airport	San Joaquin	Tracy	General Aviation
Rio Vista Municipal Airport	Solano	Rio Vista	General Aviation
Borges-Clarksburg Airport	Yolo	Clarksburg	General Aviation

Source: http://www.airport-data.com Accessed 2011-06-30

3 Energy

The largely rural and unpopulated nature of the Delta's Primary Zone makes it a valuable location for energy infrastructure; significant regional natural gas pipelines, underground natural gas storage, and electricity transmission lines are present in the region. This infrastructure provides critical linkages to nearby electrical generation facilities that are significant features of the State's power generation capacity.

3.1.1 Natural Gas

The Delta hosts major natural gas pipelines, production, and storage facilities. There are approximately 250 miles of natural gas pipeline that serve regional users and the local gas fields in the Delta. There are two major natural fields in the Delta: the Rio Vista Gas Field and the French Camp Gas Field. The Rio Vista Field, the larger of the two, is California's largest natural gas field. Combined, these two fields produced 43 percent of California's non-associated, independent-from-oil production, natural gas and 13 percent of the State's total natural gas production in 2009.[110] Pacific Gas and Electric's (PG&E) underground storage facility at McDonald Island is the largest natural gas storage facility in the state with approximately 82 Bcf of gas storage capacity, which provides up to one-third of PG&E's peak natural gas supply.[111] This natural gas infrastructure also has important linkages with the proximate electricity generation facilities.

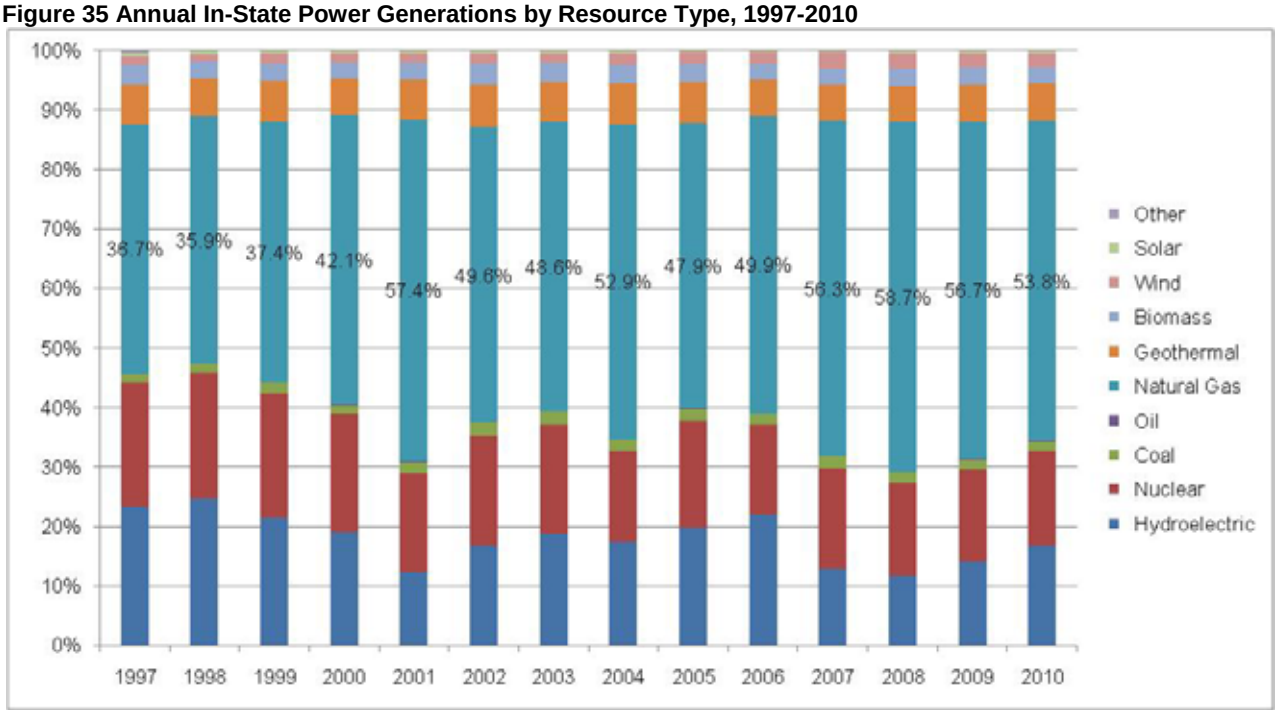
3.1.2 Electricity Generation Systems

The Legal Delta and nearby power facilities are significant sources of energy for California's electrical grid. Natural gas has become an increasingly significant resource in California's electricity generation, rising in its contribution from 37 percent of the State's total electricity generation in 1997 to 54 percent in 2010.[112] This rise in natural gas use in electricity generation is highly relevant given the Delta's natural gas infrastructure. The Legal Delta hosts 23 power plants with generation from natural gas, petroleum coke, wind, biomass, and landfill gas.[113] The most significant was natural gas-based generation; in 2010, plants within the Legal Delta generated nearly 10 percent of the State's total natural gas-based electricity, and plants within

[110] DOGGR 2010 *Report of the state oil & gas supervisor: 2009*. Department of Oil, Gas, and Geothermal Resources. California Department of Conservation.
[111] PUC 2010 California Natural Gas Infrastructure January 2010. California Public Utilities Commission.
[112] California Energy Commission. 2011*The California Energy Almanac*. Accessed 2011-06-30.
[113] For a list of the Plants, their Mw capacity, Primary Fuel, and Owner, see Appendix G.

the five-county Delta region generated nearly 20 percent of the State's total natural gas-based electricity.[114]

Figure 35 Annual In-State Power Generations by Resource Type, 1997-2010



Source: California Energy Almanac: http://energyalmanac.ca.gov/ Accessed 2011-06-30.

3.1.3 Electricity Distribution Systems

According to the 2007 Department of Water Resources *Status and Trends of Delta-Suisun Services Report,* PG&E, the Sacramento Municipal Utility District, and Western Area Power Administration oversee most of the transmission lines and provide local electricity services within the Delta.[115] There are more than 500 miles of transmission lines and 60 substations within the Delta.

3.1.4 Other Energy Infrastructure

There are also approximately 70 miles of pipeline that carry gasoline and aviation fuel across the Delta from Bay Area refineries to depots in Sacramento and Stockton for distribution to Northern California and Nevada. These pipelines provide roughly half of all transportation fuel used in this region.[116]

Lastly, it is significant that the geologic structure of the Delta's associated sedimentary basin also appears to offer promising opportunities for potential CO_2 sequestration (capture and storage of carbon dioxide). This important potential development to reduce atmospheric mad-made CO_2 emissions has identified the Delta's Sacramento Basin as one of California's five

[114] Power generation facilities in the Legal Delta generated nearly a third of the State's coal and coal-derived generation, but this only totaled 1,072 Gwh in 2010 and is a product of petroleum coke inputs supplied to these facilities from nearby oil refineries.
[115] DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft.
[116] DWR 2007 *Status and Trends of Delta-Suisun Services*. Public Review Draft.

most promising basins for CO_2 sequestration from an analysis of over 100 basins in California.[117]

4 Water Issues for Delta Communities

4.1.1 Water Supplies for Delta Communities and the Delta Region

Communities in and surrounding the Legal Delta rely on a variety of water supplies including groundwater, direct diversions from natural flows in the Delta, and diversion of surface water supplies that originate upstream from the Delta. For simplicity, this section focuses on municipal water supplies for Delta communities that divert water directly from the Delta. The largest municipal sources in this category are the Contra Costa Water District, which has several intakes in the western and south Delta, and the new City of Stockton water supply project that is currently under construction. The City of Antioch also has an important water supply intake at the western edge of the Delta, and purchases water from the Contra Costa Water District when the water quality at their intake deteriorates to poor levels. The Solano County Water Agency has a major water intake in the northwest Delta that serves significant areas in a Delta county and nearby Napa, but does not directly serve customers in the Legal Delta. The City of Tracy receives a portion of its supply from the federal Central Valley Project that serves areas to the south, but has added other supplemental supplies in recent years to reduce its dependence on this source.

As it is for agriculture, water quality is a critical consideration for these users, although its impacts can be controlled to a greater extent than for agriculture by using modern water treatment procedures—which may be very expensive. Water quality impacts on agriculture are discussed elsewhere.

There are four potential sources of significant changes in Delta water quality:

(1) Further degradation, or conversely, improvement of the water quality in the San Joaquin River. This is a long-standing problem with no easy solution. Actions directed towards improvement may be forced by an upcoming ruling of the State Water Resources Control Board, but if this does not happen, other mechanisms might be required to move forward.

(2) Proposed actions under the BDCP, both with respect to conveyance and ecosystem restoration. The BDCP proposes to construct new intakes for exporting water from the Sacramento River to areas south of the Delta. Assuming that there is no separate action taken on San Joaquin River water quality, this would tend to reduce water quality in the South Delta, which at present is sustained by cross flow of relatively fresh Sacramento River water through the Delta as it is drawn to the present export pumps. While it is reported that the current preferred conveyance alternative would include some through-Delta flow, the operating rules have not yet been fixed and there is no consensus on the BDCP effects analyses, so that the impact on South Delta water quality is uncertain, but it cannot be positive. Of the various conservation measures that have been suggested as part of BDCP, there are two in particular would have an effect on water quality in the Delta. One proposed measure is the conversion to tidal wetlands of lands around the periphery of the Delta, principally in the Cache Slough area and in the South Delta. Although very beneficial for a range of fish species because of the steady introduction of organic carbon into the rivers and sloughs of the Delta, this same increase in organic carbon can have an almost catastrophic effect on municipal water supplies

[117] Downey and Clinkenbeard, 2005. An Overview of Geologic Carbon Sequestration Potential in California. California Geological Survey.

because it can only be treated with very expensive membrane technology. Expected costs of this are noted below. A strategy for creating additional tidal marshes that would have fewer impacts to Delta water quality would be to restore the sunken islands in the far western Delta (and also perhaps Frank's Tract) as tidal marshes and to convert what are presently managed wetlands in the Suisun Marsh to tidal wetlands. This would not only have less impact on the introduction of organic carbon into municipal water supplies, but as discussed below, would also help control the tendency for salinity intrusion into the Delta as sea level rises. The second kind of conservation measure that is included in BDCP, which has potentially negative effects on water quality but positive effects on both ecosystem restoration and flood control, is the proposed use of historic floodplains to temporary store flood waters. This generally requires the removal of levees or the construction of new set-back levees. Re-activation of historic floodplains contributes to flood control by reducing the peak water-surface elevation as a flood crests and stretching out the flood hydrograph. It also directly restores one important element of the natural ecosystem, the burst of organic carbon introduced to the aquatic environment during flood crest. However, because this is only a temporary burst, rather than a sustained introduction of organic carbon, and it only occurs during periods of high flows, the consequences for municipal water treatment are not as severe. An excellent example of this approach to floodplain restoration is provided by the proposed Lower San Joaquin Bypass project which would widen Paradise Cut and reduce peak-water surface elevations in the San Joaquin River as it passes Lathrop and Stockton.[118]

(3) The third possible source of significant changes in Delta water quality is the possible increase in the rate of sea-level rise from the 6 inches or so per century that has been observed for the last three centuries. It is the policy of the State to plan for 55 inches of sea-level rise by 2100, although this has a relatively low probability of occurrence. Regardless, and regardless of the catastrophic effect that this would have on other man-made and natural communities, rises in sea level approaching this number would have a significant effect on tidal action and salinity in the Delta. However, these effects can be mitigated by adaptive management and engineering, primarily by restricting the tidal flows into the Delta by narrowing the channels in the Western Delta, in part by restoring the flooded islands to the west of Sherman Island, and by creating tidal marshes, which absorb tidal energy, in the far western Delta and the Suisun Marsh. Maintenance and improvement of the levees on the eight western islands will become even more critical as sea level continues to rise.

(4) A fourth possible source of water quality degradation is the failure of levees and the failure to restore flooded islands. As noted elsewhere, the ecological benefits of leaving islands flooded, or even deliberately breaching islands where the land surface is presently below sea level, are uncertain. What is clear, however, is that increasing open water in the Delta, is not natural, has an adverse effect on adjacent islands as a result of increasing wave action and seepage forces, and would contribute to the conversion of the Delta from an estuarine ecosystem to that of a weedy lake. Water quality would tend to be degraded both as a result of increased salinity intrusion and as a result of more organic carbon and introduced organisms.

In order to provide some idea of the expected costs of advanced water treatment, we included the following estimates that were provided by the Contra Costa Water District.

[118] Lower San Joaquin River Flood Bypass Proposal, South Delta Levee Protection and Channel Maintenance Authority, Submitted to California Department of Water Resources, March, 2011.

From FY2011 CIP: Implementation of advanced treatment technology such as membrane filtration and multiple barriers for District facilities

- Total capital cost: $ 80 M (based on 115MGD capacity, advanced treatment add-on would cost ~ $0.7/gallon)

From Annual District O&M cost: $6.6 M

- Estimate costs for based on treatment capacity

By city/agency

- CCWD (125 MGD): $87 M capital + $7.2 M/year O&M
- Brentwood (16.5 MGD): $11 M capital + $0.9 M/year O&M
- Antioch (38 MGD): $26 M capital + $2.2 M/year O&M
- Pittsburg (32 MGD): $22 M capital + $1.8 M/year O&M
- Martinez (14.7 MGD): $10 M capital + $0.8 M/year O&M

TOTAL (226 MGD): $157 M capital + $13 M/year O&M

- Accuracy Range: -30% to +50% (e.g. $110M - $ 236M for total capital)

Note: O&M should probably be scaled by average treatment, not capacity.

4.1.2 Wastewater Treatment for Delta Communities

Most Delta communities discharge treated wastewater directly into the rivers and sloughs of the Delta, contributing to environmental problems and reducing Delta water quality for human use. In recent years, the Central Valley Regional Water Quality Board has ordered virtually all Delta wastewater dischargers to significantly upgrade their plants to tertiary treatment. Some wastewater utilities are in the building process whereas others, including Sacramento the largest discharger, are in the planning stages after recent regulatory decisions by the Board. Although the costs vary between utilities, the upgrades will cost the typical household in the Delta counties $200 or more per year when fully operational compared to secondary treatment. While the improvements are costly, they are expected to make significant improvements to Delta water quality which furthers the coequal goals of the Delta Plan, and benefits the resource-related agriculture and recreation industries within the primary zone. They represent a significant investment from Delta communities, and are an action item already in progress to support the coequal goals and enhance Delta recreation and agriculture.